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**New PCT Application**  
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**CASING FOR TRANSPORTING A TONER MIXTURE AND METHOD  
FOR PRODUCING A CASING OF THIS TYPE**

The invention concerns a casing for transport of a toner mixture on its outer  
5 surface in a toner development device, whereby the wall of the casing is essentially  
comprised of an electrically-conductive material. The invention also concerns a  
method for production of such a casing.

In electrographic printer or copiers, image development methods are used that  
10 develop the electrostatic charge images on surfaces (advantageously on  
photoconductor surfaces) via an air gap or in direct contact with triboelectrically  
charged toner. The toner is frequently executed as a two-component mixture made  
from toner particles and ferromagnetic carrier particles. This two-component  
mixture is transported with the aid of a casing on its surface, whereby this casing  
15 internally contains magnets whose magnetic field, with the aid of the franking  
machine carrier particles, forms a magnetic brush on the surface of the casing that  
transports the toner particles.

A casing for a toner development device on whose surface a two-component  
20 mixture is transported is described from DE-A-2846430. In this document, it is  
viewed as a disadvantage that conventional casings use aluminum as a material in  
which eddy currents are generated due to the varying magnetic field, which eddy  
currents effect a heating of the toner material and its softening. It is therefore  
proposed there to use a material with a high electrical resistance in order to reduce  
25 the eddy current effect. The casing is accordingly produced from a copper-nickel  
alloy and the generated surface of the casing is provided with grooves parallel to  
the axis.

Furthermore, casings for transport of a toner mixture are also used in cleaning  
30 devices within a developing device. DE-A-10152892 gives an example for this.

The documents JP 03-041485 A with abstract, US 6,201,942 B1, DE 33 03 167 A1 and EP 0 800 336 A1 is [sic] as further prior art.

In practice, aluminum is conventionally used as a casing material. However,  
5 aluminum has the disadvantage that it is a relatively soft material whose surface  
wears in the course of time in printing operation. It can thereby lead to quality  
losses in the print image. In order to provide the surface of the casing with a  
harder material, it was proposed to provide the aluminum casing with a nickel  
layer on its surface. This does in fact have the desired effect with regard to the  
10 hardness, however the electrical resistance of the entire casing is hereby altered,  
which leads to a negative influencing of the electromagnetic properties on the  
surface of the casing.

A further problem in transport casings for toner is the oxidation on the transport  
15 surface. Given aluminum casings, aluminum oxide can form on the surface. The  
oxide layer likewise alters the properties of the casing material, for example the  
electrical resistance, and thus the electromagnetic parameters at the connection  
point of casing and photoconductor drum.

20 It is the object of the invention to specify a casing for transport of a toner mixture  
and a method for production of a casing, whereby important electromagnetic and  
mechanical properties are achieved for the function.

This object is achieved for a casing of the previously cited type in that the outer  
25 surface of the casing receives a layer made of nickel-copper. On the one hand this  
alloy layer has the required hardness and therewith a lower abrasion, whereby a  
higher usage duration results. On the other hand, such a layer has a high electrical  
conductivity, whereby advantageous electromagnetic properties result. The  
30 electrical resistance of this layer can be optimized via adjustment of the alloy  
ratios. Such an alloy layer can only be slightly magnetized or not magnetized at  
all, such that a disadvantageous residual magnetism is avoided. The combination

of high electrical conductivity and high hardness leads to the situation that previous aluminum casings can be exchanged for the inventive casing without electromagnetic or mechanical parameters being changed to a great extent. An oxidation of the surface is avoided due to the alloy layer.

5

For better understanding of the present invention, reference is made in the following to preferred exemplary embodiments shown in the drawings that are described using specific terminology. However, it is noted that the protective scope of the invention should not thereby be limited since such variations and 10 further modifications to the shown devices and/or the methods as well as such further applications of the invention as they are shown therein are viewed as typical present or future expertise of a competent average man skilled in the art.

Figures show exemplary embodiments of the invention, namely  
15

Figure 1 a hollow cylindrical casing for transport of toner,

Figure 2 and Figure 3 method steps for production of the surface  
layer for the casing made from aluminum.

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Figure 1 shows a cylindrical casing 10 with a surface section A. Such a casing 10 can, for example, have a length L of 500 mm, an external diameter d of 60.5 mm and an inner diameter of 56 mm. As is shown in the surface section A, the surface can have a groove structure with the parameters  $a = 0.45 \pm 0.05$  mm,  $b = 0.62 \pm 0.05$  mm and  $c = 0.5 \pm 0.2$  mm. The transport behavior of the surface of the casing 25 10 is improved with the aid of this groove structure.

The casing 10 is advantageously comprised of aluminum and bears a layer made of nickel-copper on its outer surface of the thickness in the range of 15 to 25  $\mu\text{m}$ .  
30 This layer is generated via chemical deposition, whereby a chemical nickel-copper-

phosphor deposition occurs. The layer typically contains 1 to 2 % copper and 8 to 10 % phosphor, whereby the remainder is nickel deposition.

Using a workflow diagram, Figures 2 and 3 show the chemical surface treatment  
5 for generation of the casing with the nickel-copper layer. The aluminum casing is initially degreased in alkaline solution (step 20). A flushing step 22 subsequently occurs. An etching in NaOH 30% occurs in the subsequent step 24. A flushing step (step 26) subsequently occurs.

10 A cleansing in  $\text{HNO}_3$ , i.e. an etching in nitric acid 1:1, occurs in step 28 after the alkaline etching. Because, depending on the material composition, brown to black etching slurry forms on the surface after the alkaline etching, [sic] is subsequently cleansed in nitric acid in order to prevent the formation of  $\text{AlO}_3$ . A flushing step 30 subsequently occurs in turn. An electrically conductive layer is applied in step  
15 32 in a zincate etching. The oxide layer on the aluminum material is also neutralized with the aid of this conductive layer. A flushing step 34 subsequently occurs.

Figure 3 shows the subsequent flushing step 36 with de-mineralized water, i.e. de-  
20 ionized water, from which all minerals have been extracted in an ion exchanger. The surface is chemically pre-nickled in the subsequent step 38. An inhibitor wash occurs in the subsequent step 40. A flushing in a reservoir without water feed occurs in the inhibitor wash, whereby the concentration in the wash increases. The content of the wash can then be fed back into the chemical nickel bath or be  
25 otherwise processed. Displacement [sic] losses are thus reduced. Cleansing in de-ionized water subsequently occurs in step 42.

The chemical deposition process subsequently occurs in step 44 with the nickel-copper-phosphor deposition that comprises a deposition of 1 to 2 % copper, 8 to 10  
30 % phosphor and the remainder essentially a nickel deposition. Flushing in de-ionized water subsequently occurs in step 48. A watering [sic] in 60°C water

subsequently occurs in step 48, whereby the nickel-plated parts remain in de-ionized water 2 – 3 minutes before the drying. The finished casing is dried in hot air in the concluding step 50.

5 An example for a bath preparation for nickel-copper-phosphor deposition in step 44 is reproduced in the following, whereby the composition is specified in g/l:

nickel sulfate 30 g/l  
copper sulfate 0.6 – 1.5 g/l  
10 sodium hypophosphite 15 g/l  
sodium citrate 50 g/l  
ammonium [sic] chloride 40 g/l  
pH value 9.0  
temperature (°C) 75  
15

The casing so produced can be used as a transport casing for transport of a two-component toner mixture in development devices. The transport of toner can occur between rollers or also in the form of an applicator element in the immediate proximity of a photoconductor surface. Furthermore, such a casing can be used as  
20 a cleaning device.

Although preferred exemplary embodiments are shown and described in detail in the drawings and in the preceding specification, these should be viewed as purely exemplary and not as limiting the invention. It is noted that only the preferred  
25 exemplary embodiments are shown and described, and all variations and modifications should be protected that presently and in the future lie within the protective scope of the invention.

Reference list

10	casing
L	length
5 d	outer diameter
A	surface section
a, b, c	groove parameters
20 through 50	method steps